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VARIOUS RESULTS OF BEING RESEARCHFUL[1]

By Dr. EDWARD R. WEIDLEIN

DIRECTOR, MELLON INSTITUTE OF INDUSTRIAL RESEARCH, PITTSBURGH, PA.

IN accepting the Chemical Industry Medal, I feel that I am doing so as the representative of Mellon Institute and its executive and research staffs. I think that this signal honor has come not to me as an individual but to the group of research specialists of whom I am the director, in recognition of their original contributions, and I wish to thank you for this expression in permanent form of your high opinion of the scientific and technical accomplishments of our organization. It will be pleasant to take this medal to the institute, to show it to all those who are entitled to share in the great honor conferred by it, and then to place it among our treasured possessions.

I will now describe as briefly and clearly as I can some of the productive work at the institute whose results have been accorded your recognition in the bestowal of this medal.

[1] A discourse delivered in acceptance of the Chemical Industry Medal at the meeting of the American Section of the Society of Chemical Industry, The Chemists' Club, New York, N. Y., November 8, 1935.

THE INDUSTRIAL FELLOWSHIP SYSTEM

Mellon Institute has four functions, namely: it is an industrial experiment station, a training school for industrial scientists, a center for investigation in pure as well as applied chemistry, and a clearing-house on specific scientific information for the public. Its services are seen in the numerous discoveries, the successful processes and products, achieved under its auspices, and in the regiment of keen research men who have here acquired specialized knowledge and experience that they are now applying usefully in other fields.

As an industrial experiment station—in its researches in applied chemistry and allied sciences—

Mellon Institute has for its investigational procedure the system conceived by Robert Kennedy Duncan in 1906. Duncan was then in Europe gathering material for several books on chemistry; and, through visits of inspection to factories, laboratories and universities, and through conversations with industrialists and scientists, he had become impressed at various places with the spirit of cooperation that existed between technology and science which made for the advancement of both. At the same time, he became aware, more than ever before, of the fact that much of American chemical industry, from the standpoint of manufacturing efficiency, was in a weak condition. The absence of the application of scientific research methods was one reason for this state of affairs, and Duncan was led to propose a remedy in a definite type of industrial fellowships. His plan was to assist manufacturers who desired to break away from traditional procedure and to make even more scientific that production already well on the road from tradition to science. He decided to dedicate his life to the application of this idea.

Upon his return from Europe to accept the chair of industrial chemistry in the University of Kansas, Duncan arranged for the establishment of the first industrial fellowship in January, 1907. By 1910, his great work at Kansas created a demand for his services in Pittsburgh, which, as a large industrial center, offered his special opportunities. He therefore accepted a call from the University of Pittsburgh to inaugurate his system in this institution's department of industrial research, and the operation of the fellowships was begun in a temporary building on March 1, 1911. Duncan served the University of Pittsburgh as professor of industrial chemistry as well as director of industrial research from 1910 until his death, on February 18, 1914. Andrew W. Mellon and Richard B. Mellon, citizens of Pittsburgh and sons of Judge Thomas Mellon of the class of 1837 at the University of Pittsburgh, noted the practical success of Dr. Duncan's educational experiment and saw in his system an apparently sound method of benefiting American industry by the study of manufacturing problems under suitable conditions and by training young men for technical service. In consequence of this interest, in March, 1913, they founded Mellon Institute of Industrial Research at the University of Pittsburgh, and later placed the industrial fellowship system on a permanent basis, as a memorial to their father (1813–1908) and also to Duncan. The institute was incorporated in 1927 and its affairs are managed by its own board of trustees. The continued financial support of the Mellon family has made it possible to develop the system to its strong position at this time. The present home of the institute was occupied in 1915. The new building, a beautiful edifice that has been under construction for several years, will be ready for occupancy within a few months.

The industrial research of Mellon Institute is organized on a contract basis, the problem being set by a person, firm or association interested in its solution, the scientific worker being found and engaged by the institute, and an industrial fellowship being assigned for a period of at least one year. Each holder (fellow) of an industrial fellowship is given for the time being the broadest facilities for accomplishing a definite piece of research, and all results obtained by him belong exclusively to the founder (donor) of the fellowship. Only one investigation is carried out on a particular subject at any one time, and hence there is no duplication of the research activities of the fellowships in operation. By the application of the industrial fellowship system, the institute has been successful in demonstrating to about 3,600 American companies, either as individuals or as members of industrial associations, that research, properly conducted, is profitable to them. Most of the problems accepted for study, 1911–1935, have been solved satisfactorily. The institute has also been active in stimulating research in other laboratories and in cooperating with other research establishments, both in the United States and abroad. It is best known, however, by the successful commercial processes which it has developed (582 U. S. patents) and by its voluminous contributions to the literature of chemistry and allied sciences (18 books, 122 bulletins and 1,727 papers). During the past twenty-four years the institute has received $10,029,944 from industrial fellowship donors to defray the cost of scientific investigations conducted for these companies and associations.

Duncan's Basic Work

My contact with Duncan began in 1907 at the University of Kansas. Subsequently as an industrial fellow at Kansas, during 1909–12, and at the University of Pittsburgh, 1912–14, I had the privilege of his direction and friendship. Duncan was a model of the advocate for scientific research, the advocate through love of science and through confidence in the realizable value of his industrial fellowship system. He was also a model of the laboratory manager, the ingeniously helpful research supervisor and the inspiring leader through love of his organization. "Whoever will be chief among you, let him be your servant," was the principle that he tried to live out. In the days when industrial research was practically unknown, company officers whom he met were entranced by his sincerity and tact and also by his literary works which he would always send them if they desired to learn more about science and its utility than he could describe in conference. It was in this

way that he succeeded in creating a new mental attitude among American manufacturers with respect to the importance of science in industry.

Leading a research organization is difficult work. It means bearing the brunt of responsibility, being forever focused seriously on the purpose in hand, and trying to influence others that they will want to take their own share of responsibility and enjoy their part of the load. In all activities and particularly in research laboratories a fine respect is accorded to the man who knows. And Duncan was so familiar with the technics of his procedure and its applicability that he had the full confidence of his donors, fellows and university associates.

As the application of the industrial fellowship system became more and more extensive, it was necessary to broaden purposes and to adopt plans of action to attain these objectives certainly and satisfactorily to all concerned. It was at this stage that coordination was essential, which meant that policies had to be prepared, transmitted, interpreted and worked out with donors and fellows as well as university officers.

Industrial Fellowship Researches at the University of Kansas

There was a group of deeply interested young chemists at the University of Kansas under Duncan's direction. Duncan made a team out of these workers and generated and fostered the spirit of cooperation that has characterized his system ever since. He once remarked: "It is simply extraordinary the way in which these fellows are able to help one another, as they are taught to do to a discreet extent." As the number of fellowships gradually increased, this power of discreet, mutual helpfulness increased in what might be called "geometrical progression." It is understood, of course, that personal integrity is the sine qua non to appointment to our fellowships, and that, in consequence, the institute is in a certain sense a fraternity.

Let us now view the results of some of this pioneer work in industrial research at Kansas. W. F. Faragher's investigation of laundering was the first American research in that field and uncovered much new information on detergency; upon the completion of this work he entered the employ of his donor. The most interesting outcome of H. A. Kohman's studies on the chemistry of bread was the preparation of the bacillus for making salt-rising bread; later Kohman engaged in the commercial production thereof, in which enterprise he has been successful. F. W. Bushong isolated naphthenic acids from petroleum and investigated their use in soap-making. E. W. Tillotson conducted his classical research on the relation between the physical properties of glass and its chemical constituents.

New Industries from Fellowship Researches

From 1910 until 1913, L. V. Redman was engaged at the University of Kansas, during the latter part of this time with two assistants, on an investigation of the combination of phenolic substances with hexamethylene tetramine. This work was completed at Kansas after the foundation of Mellon Institute and resulted in the commercial manufacture of "Redmanol." At the same time the analogous product called "Bakelite" had been developed by L. H. Baekeland. Later these two processes were united, and the institute carried on investigations of interest to this strong union, relating to the synthesis of formaldehyde and phenol.

Not long after the institute had been organized, an industrial fellowship was founded by the Prest-O-Lite Company to study acetylene. It must be remembered that acetylene lighting was an important industry at that time; electricity had not yet displaced it from the automobile. During the course of the investigation it was found that ethylene could be made cheaply by a new process, and the question of how to utilize this gas was an interesting economic problem. The world war solved this difficulty temporarily in the preparation of mustard gas, but the end of the war rendered it a comparatively useless product. Yet it seemed probable that some commercial uses for compounds from ethylene might be found, and the Carbide and Carbon Chemicals Corporation was organized to carry out these ideas. The success of this endeavor is well known, and the utilization of these ethylene derivatives, the processes of manufacture of which have been developed at the institute, has spread throughout the chemical industries.

The history of this rapid commercial development of organic compounds which but a few years ago were chemical rarities or unknown has been told by George O. Curme when he was awarded the Perkin Medal. Curme was the first incumbent of the fellowship, and for its accomplishments the interested specialist is referred to his account of this romance of chemistry. The wide uses that the materials have found have been in large measure due to work on the fellowship in describing accurately the physical properties, such as the solubility relations, of these various compounds. This basically essential activity has indicated the procedures to follow in the subsequent merchandising research in the instance of each product.

The background of the work that led to the use of acetylene as a starting point for the synthesis of organic compounds is somewhat similar to the history of the Carbide and Carbon Chemicals Corporation. Acetylene was available in quantity; research was necessary to point the way to successful commercial utilization. The growth of the Niacet Chemicals Corporation is a proof of the soundness of the investiga-

tional program. Acetaldehyde and its derivatives prepared synthetically have become available in large quantities as a result of this work. Acetaldehyde has achieved importance because of its usefulness in syntheses and its solvent properties. It serves as an intermediate for the preparation of the substances mentioned below as well as of acetic acid, lactic acid, quinaldine, chloral, chloroform, acetyl chloride, acetic anhydride and certain synthetic resins. Acetic acid is commercially the most important development of this work. Acetaldol, or "aldol," has valuable synthetic applications. Crotonaldehyde is a good solvent for many purposes and is used in many syntheses. Paraldehyde has found considerable use in the production of rubber accelerators and synthetic resins. It is also a good solvent for varnishes, fats, waxes, rosins, natural and synthetic resins and vegetable oils.

The Niacet Chemicals Corporation is now making and marketing certain of the cane sugar derivatives, and especially sucrose octa-acetate and calcium levulinate, whose processes of preparation, properties and uses were determined by G. J. Cox and his associates on the multiple industrial fellowship sustained by The Sugar Institute, Inc. Mellon Institute effected these commercial arrangements with the hearty approval of The Sugar Institute, when that organization of producers of sucrose decided it did not wish to embark in the manufacture of chemicals. This is a good example of cooperation between two fellowship donors.

In the early days we observed that, as the number of fellowships increased, a mutual helpfulness of the donors, one to another, appeared with striking results in numerous cases. These corporations did not know one another in all instances, because they mostly desired no publicity on the establishment of their fellowships; but as the business of all of them passed through the executive staff of the institute, many opportunities to aid appeared and were taken advantage of. Furthermore, quite outside the actual direct business of the fellowships, opportunities for general assistance to the donors frequently became evident and were followed. This practice has been cultivated throughout the development of the fellowship system, so that today the relations with the donors and the interrelations of these donors are extensive.

We have a saying in the institute that "once a fellow, always a fellow." By it is meant that we do not lose interest in the former incumbents of fellowships when they enter their donors' or other companies' organizations, nor do we lose interest in former donors. The former fellows and donors of the institute have proved to be our friends.

A lesson in the patience that is sometimes necessary to reap the reward of research comes from the history of the industrial fellowship that "put cotton shirts on wieners." Ten years passed between the first experimental work and commercial production, but the faith of the donor, E. O. Freund, in the ultimate success of a carefully planned research program did not succumb to the early disappointments.

The steps in the progress of this investigation are in many respects typical of the paths of industrial research. First of all, a thorough literature survey of the field of edible food containers was made. The possible raw materials were examined critically, and cellulose was finally chosen. It was then necessary to determine which process of using cellulose was most promising. The viscose process was finally shown to be most adaptable to the work, and the study was then directed to the modification of this method to the production of seamless tubing. The method of preparing the cellulose solution, the aging and the technic of making the film all required detailed study. The noncontinuous pilot plant was the next step, and then the continuous semi-plant scale manufacture. The solution of difficulties in adapting the finished product to actual use as a sausage casing required a long time. Finally, in 1926, the process was under way in the factory of the Visking Corporation, in Chicago. The production, measured in length of frankfurter tubing, has now attained 500 miles per day. The cellulose casings are, of course, edible. The fact that they do not stick to the sausage, however, is made use of in preparing skinless wieners.

When the Koppers Company was organized, the Koppers byproduct oven developed in Germany was taken over. Much applied research and engineering ingenuity were required to adapt it to American conditions, and, in addition, many improvements in plant design, new uses for products and betterment of the quality of coke were worked out. Prior to the entry of the United States into the world war, the Koppers Company conducted an energetic campaign for the installation of new byproduct coke ovens and benzol-recovery plants. It is probable that the greatest service of the institute to national defense was rendered in research on the recovery of toluene from carbureted water gas. The solution of this problem was reached in a short time, and toluene was soon available at a rate of 1,000,000 gallons per year. When the special demand for this hydrocarbon ceased at the close of the war, the fellowship developed a new method of gas purification in which much of the toluene-recovery equipment is employed. The same process is now in use for natural gas. Additional liquid purification procedures have been developed which permit the recovery of finely divided sulfur and other salable products.

The fellowship of the Koppers Company led to the formation of the Koppers Research Corporation,

which was active from 1930 to 1934. I will now point to an especially notable illustration of the conversion of a fellowship into a research corporation with extensive facilities.

In 1927 the Gulf Production and Pipe Line Companies, a subsidiary of the Gulf Oil Corporation, of Pittsburgh, founded a multiple fellowship in the institute for the purpose of investigating major problems in the winning, storage and transportation of crude petroleum. Paul D. Foote, a pure scientist who had distinguished himself by his researches in physics at the Bureau of Standards in Washington, D. C., was selected for the senior incumbency of this fellowship. After surrounding himself with competent assistants it did not take long for Foote to demonstrate many ways in which science and particularly chemistry and physics could be applied in the business of his donor. A number of researches relating principally to metallurgical and corrosion problems and to drilling practice were begun and carried through to successful conclusion. In 1929 this fellowship had increased its personnel to such an extent that it was decided to erect a laboratory building near the institute in Pittsburgh. This step was taken and the building was occupied early in 1930. Shortly thereafter the Gulf Research and Development Corporation was organized, with Foote as the executive vice-president. Throughout the past five years Foote's team has continued its creative work and last year it was found to be necessary to construct a group of three new laboratory buildings at Harmarville, Pa., near Pittsburgh, to house this staff and its equipment. These buildings, which were occupied last April, contain over four times as much floor space as the first building. In January, 1930, the Gulf Laboratory had ninety scientists and engineers. In April, 1935, the staff numbered 450 (including 200 specialists at work in the field). This is an impressive instance of industrial research progress during the depression.

Processing Research—New Processes

The institute's researches on new processes of manufacture have been in effect basic production investigations; they have embraced the development of more economical chemical and physical processes and the evolution of more efficient apparatus and special mechanical appliances. The researches on the improvement of present processes have included the application of the fundamental sciences associated with the industries, aiming at the prevention of industrial wastes, the elimination of difficulties in practice, the standardization of methods and the lessening of costs of operation.

Among the broadest investigations conducted at the institute have been the researches on improving flotation processes, especially for low-grade copper ores and for solid fuels. Some of these researches eventuated in the discovery of a number of new organic flotation agents. The experimental work in hydrometallurgy was scopeful, particularly during the period 1912–1915. New processes in the domain of metallurgy have related to the dealuminization of iron ore and to iron casting. A type of permanent molds for making iron castings was developed to the commercial stage. A fellowship worked out a method of chrome-plating aluminum that is in successful use.

For many years there was a multiple fellowship on fertilizer technology that had numerous accomplishments to its credit—a new contact process of making sulfuric acid, the preparation of available phosphates from phosphate rock, and the removal of fluorine from that mineral being its outstanding achievements. Recently the institute has begun research on another phosphate—sodium metaphosphate—and has devised uses for it as a water-conditioner or calcalyst (alkaline-earth soap solvent) and soap-saver in laundering ("Calgonizing"), textile processing and other operations. The novel "Hommelaya" enameling process is another late development, which is a reminder that a few years ago another fellowship invented a new sanitary enameling process that is employed to a large extent and still another fellowship discovered a method of pretreating steel to minimize hydrogen-occlusion in pickling. This latter work was done before the days of inhibitors, which we have likewise studied quite thoroughly. Wood-preserving has been investigated with commercially important results in research on zinc salts, several new processes coming from this fellowship.

The institute's fellowship on natural gas was founded in 1914 and has been active ever since. Perhaps its chief creations are processes of separating gasoline and of recovering butane and propane from natural gas. Another old fellowship—the multiple fellowship on petroleum—established in 1911 has a record that is impressive; it has had a number of prominent chemists at its helm—R. F. Bacon, B. T. Brooks, Harry Essex, W. F. Faragher and W. A. Gruse—and has contributed importantly to most of the chapters of petroleum technology. Its processes of pyrolysis and distillation are mentioned here in passing. Other organo-chemical processes evolved by fellows working at the institute pertain to beet-sugar waste recovery and utilization, paper finishing, vegetable adhesive manufacture and the production of liquid glue and keratin.

Unit Plants

Mention will be made here of the institute's "large-scale equipment." When a process, developed during

the course of a fellowship, demands apparatus of special type, which is not available in the donor's factory, a unit plant is built. This plant is of such a size and is constructed in such a way that, when it is running smoothly, the donor will feel justified in adopting its plan and investing sufficient money to put in a very much larger unit or, it may be, several units. Since 1912 many donors have authorized us to build unit plants to develop processes worked out in the laboratories of their fellowships. In no case has money for unit plants been provided in the original foundation of these fellowships; but in every instance, after discussing the subject, the donor has felt that the progress of the work and the results obtained appeared sufficiently promising to justify the expenditure of money for further development. In the case of a number of these small plants in which processes have been developed, and where the processes have gone into the commercial scale of operation, the plants are still available, being located in small, temporary buildings near the institute; and such unit plants can often be adapted to the study of other new processes. The institute has thus been gradually acquiring "large-scale equipment" that will be placed in fully adequate quarters in the new building.

A Few New Products

Many fellowships have had for their problems the creation and/or development of new products, including the working out of methods of preparation, the devising of satisfactory processes of manufacture, the discovery of commercial uses and helping to introduce the products to the professions, trades and public. I will give here some examples of this type of research.

"Arkady" yeast food, well known to American and British baking technologists, was among the first products of this class. Another creation of H. A. Kohman and his coworkers was a new shortening composition. About the same time other fellowships invented a novel composition flooring and a new dental cement. In April, 1915, J. B. Garner, a fellow of the institute, devised a gas mask, utilizing the adsorbent property of especially activated carbon, that was adopted by the U. S. Army after endorsement in Great Britain. The institute has had a fellowship on insecticides for about twenty years, and a dry lime-sulfur product, new forms of calcium arsenate and lead arsenate and the special pyrethrum extract known as "Fly-Tox" have resulted from its activities. From the researches of other fellowships of a decade ago came new detergents, perfumes and artificial waxes. Fatty acid salts of cinchona alkaloids were demonstrated to be mothproofing agents; a new branch of manufacture was founded on the successful production of silk racquet strings; a series of organic rubber accelerators was originated; formulas for a number of emulsion flavors were developed. Subsequently Heinz rice flakes and Heinz breakfast wheat, two breakfast foods, and more recently Heinz strained vegetables were created. And another late food contribution is flaked coffee.

New paper toys, specialty papers, envelope adhesives; "Alumino Hi-Temp," a heat-insulation; "Plaskon," an aminoplastic now in wide use; a new iodine antiseptic; Robertson "Keystone-Beam" steel flooring, Robertson bonded metal and "Tile-Faced" Robertson protected metal, which have recently been described in the literature; "Vici Special," a leather possessing high scuff-resisting properties; a new safety-fuse; slag products for constructional purposes; and "Thor" core binder for foundry use, have also resulted from fellowship investigations.

Advancement of Industrial Operations

A large number of fellowships have added usefully to chemical and physical technology by contributing solutions to production problems and particularly by improving manufacturing practices. Such widely different industrial fields as food packing, yeast, cosmetics, dry cleaning, mercerization, roofings, galvanizing, silverware, steel products and glassware have been quite thoroughly explored. The results of investigations of the vitrified sewer pipe fellowship led to important economies in fuel consumption in that industry. Special refractories for the zinc industry and other metallurgical purposes and for the manufacture of glass have been developed. The production of safety razor blades has been improved. New heating devices have been worked out. The manufacture of fiber containers has been studied with beneficial results.

The best known series of researches of this type related to laundering. The Laundryowners National Association supported fellowships in Mellon Institute during the period 1917–1931, and the incumbents aided importantly in applying science in laundry technology and in otherwise helping the laundry industry. One of the most useful results of this work was the system of standard practice for the power-laundry washroom, which, after thorough trial and demonstration of its practical value, was published in book form. A treatise on "Textile Fabrics," by George H. Johnson, was also written on the basis of some of the studies of the fellowships; and numerous papers descriptive of other phases of the activities were published in periodicals. The Department of Research and Tests of the Laundryowners National Association, which is located at the American Institute of Laundering, Joliet, Ill., is the outgrowth of these fellowships.

On the fur fellowship, which was sustained during the period 1926–1932 by the American Hatters Fur Cutters Association, the purpose was to develop a

method of preparing fur for felting that would avoid health hazards in hat-making by the elimination of mercury from the process and furnish light fur of a better color by the substitution of other reagents for nitric acid. Both of these objectives were achieved and the new methods of carroting gradually found their way into production in the plants of the association members. An equally important accomplishment of the fellowship was the formulation of a rational explanation of the carroting process.

New Uses for Old Industrial Products

One of the objectives of many fellowships has been to gain new knowledge respecting the properties and commercial utility of various commodities. In these activities laboratory investigation has collaborated with market research in finding new ways to increase sales. In studies in this field results of value have occasionally come directly from and have always been hastened by the advisory assistance of specialists on other fellowships of the institute.

Many donors of fellowships are constantly investigating the fitness of their products to the uses to which they are being put. These companies have raised mass production to a quality stage. Technical service studies of how such products as refractories, alloys, lacquers, plastics, insulating materials, gasoline and lubricants are satisfying the requirements of users have resulted in many improvements in these products. A recent instance in the institute has been the development of a new form of carbon black lacquer base ("Coblac"), produced as a result of several years of fundamental research work. The basic investigation of the dispersion properties of carbon blacks led to the development of a method for colloidally dispersing carbon black pigments in lacquer vehicles; this colloidal dispersion resulted in markedly improved properties for the black lacquer. The use of this new lacquer base enables the manufacturer to prepare superior black lacquers by simply dissolving it and formulating this solution with stock solutions to give the desired product. It also eliminates the troublesome and unsatisfactory pebblemill grinding of carbon blacks, because the carbon black is dispersed in the new base and retains this colloidal dispersion during subsequent solution and formulation. The superiority of such black lacquer is amply demonstrated. The pigmented lacquers prepared with this new material show remarkable improvement in color (blackness), color tone (black instead of the usual brown or gray cast), stability of pigment dispersion, remarkably increased resistance to ultraviolet exposure and weathering and surprisingly superior gloss properties. This specific improvement is an illustration of the desire of the manufacturer to put into an old product all the properties most wanted by the user of the material.

A number of years ago a fellowship had for its problem the creation of new uses for carbon dioxide and secured new information regarding the carbonation of beverages, the employment of carbon dioxide in fire extinction and the production of solid carbon dioxide. Edible gelatin was also studied broadly for the purpose of extending its uses, and this comprehensive research threw new light on the nutritional value of gelatin and its utility in the confectionery and food industries. New uses for carborundum are being sought by a fellowship now in operation and from this investigation has come the utilization of carborundum in novel types of refractories. In exploring the field of likely uses for magnesia, a fellowship found markets therefor in the rubber and pharmaceutical industries. Another fellowship has been active for a long time in effecting improvements in magnesia heat-insulation. Nickel and nickel alloys were studied by a fellowship for the purpose of securing detailed information regarding their properties, for the guidance of market research specialists.

Other industrial products for which fellowship investigations have found new uses are wood chemicals, naval stores, rosin oil, stearic acid and oleic acid (the development of triethanolamine oleate and the application of oleic acid in the textile industry). New applications have also been found for sodium bicarbonate and sodium chloride. Quite recently our multiple fellowship on sulfur learned that acid-resistant cements, made by combining sulfur with an aggregate, could be improved by the addition of certain olefine polysulfides. With the aid of these sulfides, sulfur cements can be made resistant to deterioration by fluctuating temperatures and can also be produced in varying degrees of plasticity. Such cements can be applied as bonding agents or as protective coatings in structures subjected to acids or corrosive solutions. The production of such modified sulfur cements has been undertaken by a company, according to arrangements made by the fellowship donor.

Researches on Standardization

Various fellowships have been active in the field of standardization. Standardization is generally regarded as one of the easiest approaches to greater technologic efficiency, and in our work we have had opportunities to aid certain industries to set up standards for production as well as for products. Much of this work has involved the development of analytical methods, physical testing procedures and factual information for use in the preparation of specifications. Years ago asbestos products were given thorough

attention by one of our fellowships, and later other fellowships investigated floorings, vitrified tile and writing inks from the standpoint of standardization. But the best known and most useful activities in this field have been on the fellowships relating to heat insulation, petroleum products, plastics and refractories. The incumbents of these fellowships have served on various organizational committees concerned with standardization and particularly on committees of the American Society for Testing Materials.

In illustration of such investigations, I will describe briefly some of the results of the work of the multiple fellowship of the American Refractories Institute, which has a productive history of about twenty years. The staff of this fellowship, headed by S. M. Phelps, has studied methods of measuring brick and has investigated the tolerance that should be used in preparing specifications. These scientists have devised an accurate portable instrument for the measurement of 9-inch brick that has the advantage of not being subject to the personal factor of ordinary measuring. From the data obtained in measuring a very large quantity of brick as manufactured throughout the United States, size tolerances for 9-inch brick and special shapes have been computed. This fellowship has also contrived precise and speedy methods for the estimation of alumina, iron and alkalies in refractories. Other research has led to the development of what is known as the panel spalling test, the principle of which is to expose for treatment a section of the furnace wall rather than individual brick. This test has been accepted by the industry and is now a part of the A. S. T. M. methods; the rather extensive testing equipment necessary for the procedure has also been adopted.

Some Researches for Public Good

The institute has conducted a number of researches for the benefit of the professions and of the public—investigations not usually suggested by companies, but comprehensive studies in the realm of pure science—by the financial support of the institution and through grants made by other organizations and science-minded persons. All the results of such researches are published and the literature so produced is given wide distribution.

The first of these investigations, on smoke abatement, was started in 1911 and lasted for three years. A strong staff of scientists and advisory specialists studied all phases of the urban smoke problem, and their findings were reported in nine bulletins and many journal articles. This research was recognized as of such great importance, not only to the city of Pittsburgh but to every industrial city, that the work was resumed in 1923–24 and reestablished in 1928. Since then this fellowship or air pollution investigation has become a helpful information bureau for organizations that need advice and other assistance in smoke and dust control movements and has carried out useful research on capnometry, or smoke measurement, the estimation of natural ultraviolet light, the determination of the light-screening effects of smoke and dust particles and the occurrence of carbon monoxide and sulfur dioxide in city air. Three sootfall studies have been made in Pittsburgh since 1911, the last and most extensive in 1929–30. The outstanding result of the work thus far is to show plainly that the present smoke abatement methods are utterly inadequate to cope with the problem. The great proportion of combustible and ash in the solids at low levels demonstrates the necessity for elimination at the source. H. B. Meller, the head of this investigation, has been collaborating with specialists of other organizations in evolving plans to solve this problem.

The need for knowledge relative to the pertinent factors in the cause and prevention of dental caries brought about the foundation of a multiple fellowship in 1923. The studies of this fellowship, which were continuous for nine years, were conducted with the cooperation of specialists in the School of Dentistry of the University of Pittsburgh. It was found by J. J. Enright and his associates that local environmental conditions are the main factors in the active causation of decay of fully erupted enamel and that deficient diet and defective nutrition are the important factors during the developmental period of the teeth in that these are responsible for the construction of teeth more susceptible to the action of the acids of fermentation. These studies also indicate that improper diet and defective nutrition are of some though minor importance as a predisposing factor in caries of enamel, being responsible for an environment of saliva low in calcium phosphate content. It was determined that *Lactobacillus acidophilus,* Y type, is the micro-organism commonly found in the food debris in direct contact with areas of progressive caries of the enamel. This fundamental research has received the highest commendation of dental authorities.

During 1934 G. J. Cox and Mary L. Dodds conducted some studies of the basic causes of tooth decay. In consequence of their investigational findings they pointed out that there is thereby suggested the existence of a factor which, if present in the diet during a critical period of tooth formation, will aid in the construction of teeth resistant to decay. This research is being continued along broad lines, as a pure science investigation, through a grant from The Buhl Foundation of Pittsburgh.

During the period 1924–1932 the institute carried out a comprehensive investigation of sleep, headed by

H. M. Johnson, under a grant from the Simmons Company, of New York, N. Y. Perhaps the most important experiments embraced the kind of bodily positions in which healthy persons sleep, the time that each position is held, the order in which they are taken, and the modifications of postural habits that may be effected by substituting one typical combination of bed springs and mattress for another. A greatly improved photographic recorder was invented, developed and used in these studies. The results show that a given individual may have a repertoire of a dozen or more sleeping postures that differ grossly from each other. On a typical night he resorts to nearly every one of them one or more times, unless he is physically restrained. Some of these poses are favored by nearly all sleepers; but most of the others may be divided into two groups, one of which is favored by one class of sleepers and avoided by a second class, and vice versa. It is normal for an adult to make from twenty to forty or more gross changes of posture on a typical night while children shift more often. Each pose appears to be well chosen, if considered with reference to the irritation that was set up by tenure of other poses recently taken. Poorly designed bedding equipment may limit the variety of postural changes without decreasing the number. This effect is far more important for some sleepers than for others. In many instances no important effect was found. If the sleeper was provided with a good upright coil bed spring and a good interior-spring mattress, no restful poses appeared to be discriminated against.

Throughout the period 1926–1931 there was in operation a fellowship that investigated searchingly the effects of aluminum on foods. An extensive study of pasteurizing or boiling milk in aluminum showed the metal to be entirely without specific effect in the destruction of vitamin C. Another research was concerned with the absorption of aluminum from the alimentary tract. Analysis of the tissues of animals that had consumed foods containing as much as a hundred times the amount of aluminum which would come from utensils by corrosion revealed the naturally present aluminum to be only very slightly increased. Many of the animals subsisted on the aluminum-containing diets continuously for 18 months. The results of the entire investigation proved that aluminum is not a poisonous metal and does not give rise to any disease, that aluminum utensils are very resistant to corrosion by foodstuffs cooked therein, and that aluminum does not accelerate the destruction of vitamins or other food accessory substances during cooking.

Training for Industrial Service

The institute has lately been giving more and more attention to the important branch of industrial research that treats of the personal and official duties of the investigatory staff, in distinction from the better developed subject of systematic research, which deals with literature studies, planning and experimental methods.

This branch has a valuable place in training young scientists for industrial and public service, principally because it imparts a large amount of useful information, largely gleaned from the experience of the institute's executive staff, that is not acquired in scientific courses in the universities. All fellows of the institute are instructed in business correspondence and in commercial procedures in general, in technical reporting, in the minutiae of professional ethics, and, most important of all, in the psychology of the industrial mind. The relative prominence accorded to this subject makes it gradually easy for a young scientist of correct attitude to appreciate the industrial point of view. It teaches him to convey to the industrial executive the ideas of science and the results of research in a manner and language that can be easily comprehended. In industrial research, particularly in the practical connections with the companies sustaining their fellowship work, the art of making and keeping contact and of promoting cordial relations is of constant utility to the fellows. It is of great aid in securing essential cooperation and in gaining the confidence that results, of course, primarily from research accomplishment and technical merit. All successful industrial research is built upon trust.

Department of Research in Pure Chemistry

The institute has funds that enable it to sustain a Department of Research in Pure Chemistry, which was established in 1927 and has since been headed by L. H. Cretcher. This department is concerned with the investigation of important chemical problems of strictly scientific interest. Its aim is to contribute to the advancement of the science and profession of chemistry and to aid advisorily industrial fellowships of the institute. This attitude is the result of altruistic motives and of the realization that fundamental chemical studies are essential as a background and stimulus for industrial research. So far the researches have been entirely in the province of organic chemistry, but in the institute's new building the scope of this department's activities will be widened to embrace other branches of pure chemistry.

In 1931 the department started researches in the field of the cinchona alkaloids, which, it was hoped, might eventuate in the discovery of compounds possessing therapeutic usefulness. During 1932–3 many new cinchona derivatives were evaluated therapeutically, in cooperation with internists, especially in the

treatment of pneumonia. This work was continued during 1933–4 and a large number of preparations were tested for toxicity, protection against lethal doses of pneumococci in animals and pneumococcocidal power in vitro. Throughout the period 1933–35 many biological and clinical data were accumulated by the medical collaborators, Dr. W. W. G. Maclachlan and his associates, Drs. H. H. Permar, John M. Johnston, Joseph R. Kenny and H. B. Burchell. To date the most interesting compounds studied, from the medical point of view, have been hydroxyethylhydrocupreine, apoquinine, ethylapoquinine and hydroxyethylapoquinine. C. L. Butler, Alice G. Renfrew and B. L. Souther, assisted by Mary Hostler, are conducting these chemical studies of cinchona derivatives under Cretcher's direction.

For six years Mellon Institute has been supporting broad investigational work in the Institute of Pathology of the Western Pennsylvania Hospital in Pittsburgh, through arrangements made by Dr. C. B. Schildecker. These studies, which are being carried on by a group of scientists under the direction of Dr. R. R. Mellon, relate mainly to the treatment of pneumonia and allied pulmonary diseases and have resulted in the production of an apparently effectual antipneumococcic serum. Considerable advancement has also been made in an anti-streptococcic serum.

A Word of Appreciation

As the director of an industrial research institution, it has been my pleasant task to assist in infusing science in technology and particularly in the chemical industry. My problem has been twofold—to convince manufacturing organizations of the functions of scientific research and research management in the industries, and to aid in educating the public to a greater appreciation of the value of science. This problem is only partially solved; I can merely report progress. But the fellows of the institute have made themselves felt as an integral group in the industrial body; and their accomplishments are not only inspiring, they are facilitating greatly my own work. Thanks to these fellows, Mellon Institute is regarded generally as a strong link between the world of science and the industries. What about the future? I believe that all of us at the institute will have much greater encouragement and opportunities and that we shall be able to do many more useful things when we have the advantage of working in our new building with its splendid facilities for research in pure as well as applied science.

OBITUARY

HARRY SCHELWALDT SWARTH

By the death at his home in Berkeley, California, on October 22, of Harry Schelwaldt Swarth, at the age of fifty-seven, ornithology has been deprived of one of its most devoted and able workers.

Mr. Swarth was born in Chicago, Illinois, on January 26, 1878, and was educated in the schools of that city and Los Angeles, where his parents moved in 1891. His interest in natural history manifested itself early, and under the guidance of G. Frean Morcom every opportunity was afforded for its development.

In 1896 he made a field trip to Arizona, by which he initiated the work in that state which he carried on intermittently until his death, and which resulted in his "Birds of the Huachuca Mountains," "Distributional List of the Birds of Arizona" and "Faunal Areas of Southern Arizona."

The Klondike gold rush drew him to the north in 1898, and then there was awakened his interest in this region that took him back again and again to Vancouver Island, to the Sitkan region, to the Stikine and Skeena valleys and to Atlin, where he had planned to end his days. These trips were very productive, and gave him material for many papers, notably his "Birds and Mammals of the Stikine River Region of Northern British Columbia and Southeastern Alaska," "Birds and Mammals of the Skeena River Region of Northern British Columbia," "Report on a Collection of Birds and Mammals from the Atlin Region" and (in conjunction with Major Allan Brooks) "Distributional List of the Birds of British Columbia."

During the years in which this work was being carried on, Mr. Swarth had served as assistant in the department of zoology, Field Museum (1905–08); curator of birds, Museum of Vertebrate Zoology, University of California (1908–12; 1915–27); and assistant director, Museum of History, Science and Arts, Los Angeles (1913–15).

His years at the Museum of Vertebrate Zoology were very productive ones. In addition to the many papers on northern faunal areas, he published independently and in collaboration with Dr. Joseph Grinnell many papers on the birds and mammals of California and Lower California, and revised several groups. Among the more important of them was his "Revision of the Avian Genus Passerella."

The Cooper Ornithological Club was, from its inception, one of Mr. Swarth's strongest interests and, whether in Berkeley or in Los Angeles, he participated in its activities. He was treasurer of the Southern Division from 1898–1903, vice-president of the Northern Division in 1921 and president in 1922. In 1910 he became associate editor of *The Condor,* and this office he continued to fill until 1927. His "C. O. C., 1893–1928," is indispensable to one desiring a proper understanding of this organization and its activities.

Californian societies did not engross his whole attention. He was a member of the Wilson Ornithological Club, the Biological Society of Washington and the American Society of Mammalogists, and fellow of the American Association for the Advancement of Science and the American Ornithologists' Union. He was present at meetings of the Union whenever possible, and was ever closely in touch with A. O. U. concerns. The "Ten Year Index to the Auk (1921–1930)" made its successful appearance in 1934, largely due to Mr. Swarth's painstaking editing.

In 1927 Mr. Swarth became curator of the Department of Ornithology and Mammalogy of the California Academy of Sciences, a position he held until his death. On going to the academy, he immediately gave his attention to the study of the institution's collection of Galapagos birds, and during the next few years he was occupied here and in Europe studying the problems presented by these birds. His solutions are to be found in his "Avifauna of the Galapagos Islands."

The work he had done on Galapagos material and the knowledge of the islands he acquired during a visit he paid there in 1932 on Mr. Templeton Crocker's yacht *Zaca* gave him an appreciation of the importance of protecting the various forms of animal and plant life found there. After some fruitless correspondence he finally got into communication with Robert T. Moore, of Los Angeles, whose knowledge of Ecuador and its people placed him in a position to bring to a successful conclusion the efforts for legislation to provide adequate protection for the fauna of the islands.

Mr. Swarth's labors in ornithology and mammalogy failed to crowd out his human interests. His knowledge of music and art and literature and his quiet humor made him a delightful conversationalist. He was slow in making new friends, but his sincerity and kindness, his fairness and dependability won him the warm regard of all who knew him.

M. E. DAVIDSON

RECENT DEATHS

DR. LAFAYETTE B. MENDEL, Sterling professor of physiological chemistry at Yale University, died on December 9 in his sixty-fourth year. Mrs. Mendel died less than a month ago.

WALTER BUTLER HARRIS, professor emeritus of geodesy in the engineering faculty of Princeton University, died on November 21 at the age of seventy years.

DR. CHARLES RICHET, the physiologist, professor of medicine in the University of Paris, a member of the French Academy of Medicine and the Paris Academy of Sciences, died on December 3 at the age of eighty-five years. Dr. Richet was awarded in 1913 the Nobel prize in physiology and medicine.

THE death is announced of Professor Etienne, of Nancy, known for his studies in neurology, with special reference to poliomyelitis.

MEMORIALS

TWO stone lanterns, symbolizing the Japanese conception of "eternal light," were presented to the Thomas Alva Edison Foundation on December 2 on behalf of the Electrical Association of Japan. The presentation was made by Renzo Sawada, Japanese Consul General, at the Edison Library and Laboratory in West Orange, N. J. The lanterns are more than six feet high and weigh more than 4,300 pounds each. They will remain in the custody of the foundation and will be set up temporarily in the museum adjoining the library.

PLANS are being made at Greenock, Scotland, for the celebration in January of the bicentenary of the birth of James Watt. The Watt anniversary lecture will be delivered on January 17 by Lord Rutherford and a memorial service will be held in the Town Hall on January 19, the date of Watt's birth. The schools will present a Watt pageant, and a memorial plaque will be unveiled in the Watt School of Engineering and Navigation, which stands on the site of the house where Watt was born.

THREE streets in Paris have been recently named, respectively, after M. Grancher, late professor of pediatrics in the University of Paris; M. Dejerine, the successor of Charcot, and M. Emile Roux, the former director of the Institut Pasteur.

SCIENTIFIC EVENTS

SUBSTITUTION OF THE PRACTICAL ABSOLUTE SYSTEM OF ELECTRICAL UNITS FOR THE EXISTING INTERNATIONAL SYSTEM[1]

IN accordance with the authority and responsibility placed upon it by the General Conference of Weights and Measures in 1933, the International Committee of Weights and Measures has decided that the actual substitution of the absolute system of electrical units for the international system shall take place on January 1, 1940.

In collaboration with the national physical laboratories, the committee is actively engaged in establishing the ratios between the international units and the corresponding practical absolute units.

[1] Approved by the International Committee of Weights and Measures at its meeting in October, 1935, at Sèvres, France.

The committee directs attention to the fact that it is not at all necessary for any existing electrical standard to be altered or modified with a view to making its actual value conform with the new units. For the majority of engineering applications the old values of the international standards will be sufficiently close to the new for no change, even of a numerical nature, to be required. If for any special reason a higher precision is necessary, numerical corrections can always be applied.

Table I gives a provisional list of the ratios of the international units to the corresponding practical absolute units, taken to the fourth decimal place. Since differences affecting the fifth decimal place exist between the standards of the international units held by the various national laboratories and also because all the laboratories which have undertaken determinations of the values of their standards in absolute measure have not yet obtained final results, the committee does not consider it desirable for the present to seek a higher precision. At the same time it hopes that it will be possible to extend the table of these ratios with a close approximation to the fifth decimal place well before the date fixed for the actual substitution of the practical absolute system for the international system.

TABLE I

1	Ampere	international	= 0.999	9	Ampere	Absolute
1	Coulomb	"	= 0.999	9	Coulomb	"
1	Ohm	"	= 1.000	5	Ohm	"
1	Volt	"	= 1.000	4	Volt	"
1	Henry	"	= 1.000	5	Henry	"
1	Farad	"	= 0.999	5	Farad	"
1	Weber	"	= 1.000	4	Weber	"
1	Watt	"	= 1.000	3	Watt	"
1	Joule	"	= 1.000	3	Joule	"

REORGANIZATION OF THE WASHINGTON HEADQUARTERS OF THE FOREST SERVICE

REORGANIZATION of the Washington headquarters office of the Forest Service and reassignment of a number of staff members has been announced by F. A. Silcox, chief of the service.

The reorganization involves consolidation of the functions of eight former branches into four major groups covering National Forest administration, state and private forestry cooperation, operation and information and research. Land acquisition, a Forest Service function for many years, is provided for in a separate unit, as are all activities in connection with Emergency Conservation Work.

The grouping of divisions having to do with associated functions will form a more compact organization. It is designed to handle more effectively the greatly expanded work the Forest Service has been called upon to carry out in connection with emergency conservation activities.

Under the new plan, more adequate provision has been made for taking care of wildlife management on the national forests, recreation, personnel management and certain other functions formerly handled as part of the work of other branches. Reorganization of the ten regional offices of the Forest Service has also been effected.

Earle H. Clapp has been appointed associate chief of the service; E. A. Sherman as assistant chief and adviser to the chief, and Earl W. Loveridge assistant chief on Mr. Silcox's staff. R. F. Hammatt will serve as assistant to the chief. The Division of Fiscal Control, which is an independent audit unit, is headed by H. I. Loving.

C. M. Granger has been named assistant chief in charge of national forests. Under Mr. Granger's general direction are the Division of Fire Control and Improvements, Timber Management, Range Management, Recreation and Lands, Engineering, and a new Division of Wildlife Management. Before his present assignment Mr. Granger was regional forester at Portland, Ore., then director of the forest survey, and later was placed in charge of the Forest Service's part of the Civilian Conservation Corps program.

To head the state and private forests group, Earl W. Tinker, now regional forester in charge of the north central national forest region with headquarters at Milwaukee, is being transferred to Washington as as assistant chief of the Forest Service. This group will include the division of state forest purchase and regulation, which will handle cooperation with state agencies in the purchase and management of land for state forests contemplated under the recently enacted Fulmer bill; the division of forest code which is responsible for cooperation with industries and private timberland owners in promoting forest conservation; and the division of state cooperation, which cooperates with the states in organized fire protection and in production and distribution of trees for farm planting under the Clarke-McNary Act of 1924.

Assistant Chief Earl W. Loveridge, appointed to a staff position, has been assigned as acting head of the operation and information group, including the divisions of operation; information and publication, and personnel management.

Acting in charge of research is R. E. Marsh, with the divisions of silvics, forest economics, range research and forest products under his general supervision.

L. F. Kneipp, formerly in charge of the branch of lands, has been placed in charge of acquisition, the unit which handles land planning activities and the program for purchase of lands for national forest purposes.

Fred W. Morrell, who headed the former branch of public relations, and was, previous to that assignment,

regional forester at Missoula, Mont., has been placed in charge of Emergency Conservation Work and will have under his direction all Forest Service activities in connection with the Civilian Conservation Corps, including allocation of camps and planning and supervision of work projects.

These appointments are effective immediately, with the exception of the assignment of Mr. Tinker, which will be effective as of January 1, 1936.

PROGRAM OF THE AMERICAN INSTITUTE

MORE than 100 events, planned to bring the discoveries of science to the general public, or to interpret the social and economic implications of modern scientific developments, are announced by the American Institute in its 108th annual program, at its offices in the Lincoln Building, New York City.

There are 36 meetings or other events on the adult program, 16 on the associate program and 45 on the junior program.

The adult program consists of twenty-seven meetings, including eighteen round tables, eight large general meetings on science and one dinner meeting at which the institute will award its gold medal "for outstanding work in science which has a broad incidence on human welfare."

Prominent figures in various fields of scientific research will lead the round table discussions. Topics and speakers of these panels include: "Science in Crime Detection," led by H. H. Clegg, assistant director of the Federal Bureau of Investigation of the United States Department of Justice; "Casting the 200-inch Glass Reflecting Mirror for the World's Largest Telescope," discussed by A. E. Marshall, president of the American Institute of Chemical Engineers, and "The Asylum Passes," led by Dr. Ross McClure Chapman.

The large general meetings will include such subjects as: "The Promise of Television"; "Recent Discoveries in Biology and Medicine," and "The Applications of the Scientific Method to the Problems of Society."

The associate members' program, designed for young men and women of college age, will consist of some 16 meetings, including 9 round table discussions, 3 field trips, 2 meetings at which the associate members themselves will present the talks and demonstrations and 2 social evenings. The associate member round tables will be similar in character to those for adults and will include such subjects as "The Chemistry of Vitamins and Hormones," "Cellulose in Our Modern Chemical Industry," "Psychological Vagaries in Mental Disease" and "Earthquakes."

The field trips are the outstanding novelty of the college-age program. On November 9 the associates were taken on a "Tour of the Research Laboratories of Columbia University Devoted to the Separation of Isotopes," conducted by Dr. Harold C. Urey. On January 31 a second field trip will be made to the Research Bureau Laboratories of the Brooklyn Edison Company. This trip will be conducted by Ward F. Davidson, director of research.

The program for junior and senior high school children reaches the 5,000 boys and girls who are members of the institute's student science clubs. These junior activities are planned to give the outstanding science pupils of the city the advantage of scientific training supplementary to the school curriculum. This is done through a series of free workshop courses in science given in conjunction with the institute by New York University and the science museums of the city. The program also includes three large meetings at which prominent scientists give demonstration talks.

At Christmas time there will be a series of "Christmas Lectures" which will be combined with a Science Congress where the boys and girls themselves read papers and discuss their work in the science clubs during the term. This congress is based in plan on meetings of the American Association for the Advancement of Science, with a dozen section meetings on different science subjects.

In the spring the institute's annual Children's Science Fair will be held, at which any boy or girl in the city, under eighteen years of age, may show his work in science and compete for prizes to be spent for further research.

THE NEXT INTERNATIONAL GENETICS CONGRESS

AT the sixth International Genetics Congress, which was held at Ithaca, New York, in 1932, a Permanent International Committee of Genetics Congresses was elected consisting of representatives of fifteen different countries. The undersigned was asked to serve as chairman of this committee, the chief function of which was to designate the country in which the next congress is to be held.

After preliminary discussions of different alternatives the committee had the honor of receiving from the Presidium of the Academy of Sciences of the USSR an official invitation for the holding of the seventh International Congress in Moscow and Leningrad in 1937. In the invitation it is stated that the Academy of Sciences and its institutes, as well as other scientific institutions of the USSR, will be glad to devote their efforts to the organization of this congress. The invitation was signed by A. A. Borisjak, permanent secretary of the academy, and N. I. Vavilov, member of the International Committee of Genetics Congresses.

This invitation was submitted to the members of the International Committee and the committee has resolved to accept the invitation with sincere thanks.

The exact date for the holding of the congress will be decided upon later. In 1937 there will be arranged in Moscow an All-Union Agricultural Exhibition, which undoubtedly will prove of interest to many members of the Genetics Congress.

OTTO L. MOHR

OSLO

THE AWARD OF THE MEDALS OF THE ROYAL SOCIETY AND THE ELECTION OF OFFICERS

THE following awards of medals have been made by the president and council of the Royal Society:

A Royal medal to Professor C. G. Darwin, F.R.S., for his researches in mathematical physics, especially in the quantum mechanics of the electron and in optics.

A Royal medal to Dr. A. Harker, F.R.S., in recognition of his distinguished work and influence as a petrologist.

The Copley medal to Professor C. T. R. Wilson, F.R.S., for his work on the use of clouds in advancing our knowledge of atoms and their properties.

The Davy medal to Professor A. Harden, F.R.S., for his distinguished work in biochemistry and especially for his fundamental discoveries in the chemistry of alcoholic fermentation.

The Hughes medal to Dr. C. J. Davisson for research resulting in the discovery of the physical existence of electron waves through long-continued investigations on the reflection of electrons from the crystal planes of nickel and other metals.

The following is a list of those recommended by the president and council for election to the council of the Royal Society at the anniversary meeting:

Sir William Bragg, president; Sir Henry Lyons, treasurer; Sir Frank Smith and Professor A. V. Hill, secretaries; Professor A. C. Seward, foreign secretary.

Other members of council:—Professor E. D. Adrian, D. L. Chapman, Professor A. W. Conway, Dr. W. H. Eccles, Professor A. S. Eve, Professor L. N. G. Filon, Dr. J. Gray, Sir Daniel Hall, Dr. S. W. Kemp, Sir Patrick Laidlaw, Sir Gerald Lenox-Conyngham, Dr. G. T. Morgan, Professor R. Robison, Dr. B. Smith, Professor W. Stiles and W. Trotter.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM F. DURAND, professor emeritus of mechanical engineering at Stanford University, was presented with the John Fritz Medal on December 4 at the annual meeting in New York City of the American Society of Mechanical Engineers. The award was made to Dr. Durand as an "authority in hydrodynamic and aerodynamic science, and its practical application" and as "an outstanding leader in research and in engineering education." Other awards were made as follows: Charles T. Main, of Boston, past president of the society, the society's medal; Stephen Timoshenko, professor of mechanical engineering at the University of Michigan, the Worcester Reed Warner Medal; Oscar R. Wikander, of Pittsburgh, the Melville Medal; Stanley J. Mikina, of East Pittsburgh, the junior award; G. Lowell Williams, a graduate of Lafayette College last year, the Charles T. Main award, and Charles P. Bacha, of last year's graduating class at Rutgers University, the student award.

DR. F. G. DONNAN, professor of chemistry in the University of London and director of the Chemical Laboratories at University College, has been elected a foreign member of the Division for Chemistry of the Royal Physiographical Society of Lund.

THE Buckston Browne Prize for 1935, of the Harveian Society of London, has been awarded to William Robert Fearon, of Trinity College, Dublin, for his essay on "Nutritional Factors in Disease."

PROFESSOR ALBRECHT PENCK, of the University of Berlin, has been elected an honorary member of the Geographical Association of Sofia.

AT the recent annual convention in Washington of the Association of Land Grant Colleges and Universities, Dr. A. R. Mann, provost of Cornell University, was elected chairman of the executive committee. Dr. Mann succeeds Dr. Raymond A. Pearson, formerly president of the University of Maryland and previously president of the Iowa State College, who has been for the past twenty years a member of the committee, during the last seventeen years its chairman. The association adopted resolutions recognizing Dr. Pearson's distinguished services to the Land Grant Colleges covering a period of thirty-five years. A testimonial breakfast was tendered to him by the presidents of the Land Grant Colleges in attendance at the convention.

DR. O. M. DICKERSON, of the Colorado State Teachers College at Greeley, was elected president of the Colorado-Wyoming Academy of Science at the ninth annual convention, held at Colorado College on November 29. Dr. Dickerson succeeds Dr. E. B. Renaud, of the University of Denver. Other officers elected were: B. E. Cohn, of the University of Denver, *vice-president;* H. B. Van Valkenburgh, of the University of Colorado, *secretary;* C. T. Hurst, Western State College, Gunnison, *treasurer;* W. D. Robertson, Colo-

rado State College, and W. E. Roloff, Colorado School of Mines, members of the executive committee.

THE American Society of Tropical Medicine met on November 20, 21 and 22 in St. Louis, Mo. The society held its regular meeting and programs, and in addition had joint sessions with the American Academy of Tropical Medicine and the Southern Medical Association. The society had as its guest Dr. N. Hamilton Fairley, of the London School of Hygiene and Tropical Medicine, who spoke on "Recent Advances and Hiatuses in our Knowledge of Tropical Sprue." The following officers were elected: *President,* Dr. Henry E. Meleney; *President-elect,* Dr. Herbert C. Clark; *Vice-president,* Dr. Alfred C. Reed; *Secretary-treasurer,* Dr. N. Paul Hudson; *Editor—Reelected,* Dr. Charles F. Craig; *Newly Elected Councilors,* Dr. Thomas T. Mackie, Dr. M. H. Soules and George W. Bachman.

A "PACIFIC NORTHWEST SOCIETY OF PATHOLOGISTS" has recently been organized. The membership is confined to members of the medical profession, limiting their activities principally to pathology and the allied sciences. Members must have qualifications equal to those required by the American Society of Clinical Pathologists and the American Society of Pathologists and Bacteriologists. The present officers are Dr. F. R. Menne, *president;* Dr. O. H. Nickson, *vice-president;* Dr. Thomas D. Robertson, *secretary-treasurer.*

Nature states that the second local section of the Institute of Physics to be formed in Great Britain was inaugurated at a meeting held at the University of Birmingham on November 15. Professor S. W. J. Smith was elected chairman, and Dr. J. H. Mitchell, of the British Thomson-Houston Research Laboratory, local honorary secretary. The inaugural lecture was given by Dr. J. D. Cockcroft, of the Cavendish Laboratory, Cambridge, who took as his subject "Recent Work on Nuclear Transmutations."

DR. N. PAUL HUDSON, recently professor of bacteriology at the University of Chicago, is now professor and chairman of the department of bacteriology at the Ohio State University. He succeeds Dr. C. B. Morrey, who retired with the title of professor emeritus at the end of the academic year. Dr. Jorgen M. Birkeland, Dr. Floyd S. Markham, Dr. Grant L. Stahly and Dr. Oram C. Woolpert have been appointed assistant professors.

DR. FRED W. MORSE, research professor of chemistry at Massachusetts State College since 1910, retired on December 7, having reached the mandatory retirement age set for state employees.

THE resignation of Jesse D. Figgins, director of the Colorado Museum of Natural History, has been announced.

FRANK KIERNAN, formerly executive secretary of the Massachusetts Tuberculosis League, has been elected director of the New York Tuberculosis and Health Association. Mr. Kiernan succeeds to the position left vacant by Harry L. Hopkins, who resigned two years ago to become Federal Emergency Relief Administrator in Washington. During the interim Godias J. Drolet, statistician of the association, has been the acting director. The staff of the organization gave a dinner on December 6 at the Hotel Pennsylvania in honor of Mr. Kiernan's association since 1915 with the anti-tuberculosis movement.

DR. S. S. GOLDWATER, commissioner of hospitals, has announced that, in accordance with a recommendation from the New York Academy of Medicine, the formerly part-time position of director of psychiatry, left vacant in June, 1934, by the resignation of Dr. Menas S. Gregory, has been placed upon a full-time basis. Dr. Karl Murdock Bowman, chief medical officer of the Boston Psychopathic Hospital, has been appointed to the position at a salary of $9,000 a year. Dr. Gregory has accepted the position of consultant psychiatrist to the department.

PROFESSOR EJNAR HERTZSPRUNG, professor of astrophysics in the University of Leyden, and assistant director of the Leyden Observatory, has been appointed director of the observatory to succeed the late Professor Willem de Sitter.

THE Cutter lecture on preventive medicine was recently given at the Harvard Medical School by Dr. Milton J. Rosenau, Charles Wilder professor of preventive medicine and hygiene, *emeritus.* He spoke on "Epidemics."

THE Western Reserve University Chapter of the Society of the Sigma Xi has inaugurated its 1935–36 program with a series of biological studies. On October 14 Dr. F. H. Herrick, professor emeritus of biology at Western Reserve University, spoke on "Instinct." On November 1 H. H. Newman, professor of zoology at the University of Chicago, spoke on "A Study of Identical Twins Reared Apart." On December 2 Morris Steggerda, investigator in the department of geneties at the Carnegie Institution, spoke on "Some Biological Aspects of the Maya Indians of the Yucatan Peninsula."

PROFESSOR F. RASETTI, of the University of Rome, spoke on November 29, before the weekly colloquium of the department of physics of Cornell University, on "Recent Investigations with Slow Neutrons."

DR. C. E. KENNETH MEES, vice-president in charge of research and development in the Eastman Kodak Company, will deliver six Christmas lectures on "Photography" at the Royal Institution, London, beginning on December 28.

DR. EDWARD MELLANBY, secretary of the British Medical Research Council, is delivering a series of lectures entitled "A Survey of Modern Views of Nutrition" at the Royal Institution, London.

The Toronto Telegram reports that in connection with a proposal to establish a botanic garden in Toronto, Dr. H. T. Güssow, the Dominion botanist in Ottawa, gave an illustrated address before the Royal Canadian Institute on November 30, on "Botanic Gardens for Canada." Sir Robert Falconer is chairman of the committee in charge of the garden project in Toronto. A ravine area in which development of native flora as well as plants from abroad could be effected is favored by the committee.

A LIMITED number of post-doctorate fellowships in the fields of the physical sciences and chemistry, the medical sciences and the biological sciences, including anthropology and psychology, will be available through the National Research Council for the academic year 1936–37. These fellowships carry stipends from $1,600 upward with certain allowances for dependents and are open to citizens (men and women) of the United States and Canada under the age of thirty-five years, for study in the United States or, under special conditions, abroad. Applications for appointment to these fellowships should be filed with the secretary of the appropriate board as follows: The National Research Fellowship Board in Physics, Chemistry and Mathematics, before March 1, 1936; the Medical Fellowship Board, before January 1, 1936, and the Board of National Research Fellowships in the Biological Sciences, before February 1, 1936.

THE Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. For application forms, please address the Committee at 535 North Dearborn Street, Chicago, Illinois.

THE eastern première of the University of Chicago's talking motion pictures in geology was held in the Connecting Wing Auditorium in Washington on October 30, and the first western showings were held concurrently in Mandel Hall and International House, University of Chicago, on November 11. Nearly 4,000 persons attended these premières of the six reels which are entitled: The Work of Running Water, The Work of Ground Water, The Work of Ice, The Work of the Atmosphere, Mountain Building, Volcanoes in Action. The pictures were prepared under the direction of Dr. Carey Croneis, of the University of Chicago, with the cooperation of James Brill and Dr. Melvin Brodshaug, of the Erpi Picture Consultants, New York, and Dr. H. C. Bryant and Earl Trager, of the National Parks Service. These films, designed for college instruction, are also being used in the CCC camps.

THE American Science Teachers Association will meet at the Statler Hotel, St. Louis, on January 2. The chairman of the association is Harry A. Carpenter, specialist in science of the Rochester schools. The conference will be held in conjunction with the American Association for the Advancement of Science. Addresses will be made in the morning by Dr. George T. Moore, director of the Missouri Botanical Garden; Dr. Russell M. Wilder, professor and chief of the department of medicine, Mayo Foundation for Medical Education and Research, University of Minnesota, Rochester, and Dr. Orestes H. Caldwell, editor of *Radio To-day*, New York City. There will be a luncheon at twelve o'clock presided over by Dr. Otis W. Caldwell, chairman of the Committee on the Place of Science in Education of the American Association for the Advancement of Science and general secretary of the association. Following the luncheon Dr. Karl T. Compton will make an address. In the afternoon there will be a series of special papers. An exhibition of pupil work in science has been arranged.

THE twenty-second annual meeting of the National Council of Geography Teachers will be held in the Hotel Chase, St. Louis, on December 27 and 28. There will be five sessions and a dinner. For Sunday, December 29, a field trip around St. Louis is scheduled. A national broadcast over the Columbia Broadcasting network will occur. Speakers and discussion leaders from various sections of the country will consider (1) The Content of Geography for Beginners, (2) Geography in the Senior High School, (3) Advertising Geography, (4) Professionalized Subject Matter in Geography, (5) Geography in World Relationships. Requests for programs and further information concerning the annual meeting may be addressed to Erna Grassmuck, chairman, Educational Relations Committee, State Teachers College, Indiana, Pennsylvania. The officers of the National Council are: *President*, C. E. Cooper, Ohio University, Athens, Ohio; *First vice-president*, Alison E. Aitchison, Iowa State Teachers College, Cedar Falls; *Second vice-president*, Floyd F. Cunningham, State Teachers College, Florence, Ala.; *Secretary*, William J. Berry, State Teachers College, Kalamazoo, Mich.; *Treasurer*, H. Harrison Russell, State Teachers College, Bloomsburg, Penna.

GOVERNOR HERBERT H. LEHMAN'S Commission for the Study of the Educational Problems of Penal Institutions for Youth has received an additional grant of $12,500 from the Carnegie Corporation of New York.

DISCUSSION

THE DIVING HABITS OF THE BEAVER

THERE are many interesting accounts of the habits of the beaver, but we have not yet seen any report of a critical examination of the behavior of beavers during submergence. During a recent visit to Algonquin Park, Ontario, through the courtesy of Mr. F. A. Macdougall, superintendent, we were enabled to make some observations on a living animal. The beaver was caught by ranger George Heintzman in a live trap near Opeongo Lake. It was in excellent condition and weighed about 40 pounds.

Its movements were slow and deliberate, but when it once reached the water it swam and dived violently. When returned to an open-topped box it soon became quiet. Within fifteen minutes one of us had firmly placed one hand on the nape of the beaver's neck and with the other hand could feel the heart beating regularly and strongly at 100 per minute.

The box was then placed at the edge of the lake, so that the animal was just awash. With its nostrils just above the water, the heart-beat after a half hour of rest was 50 and irregular, while respiration went on regularly and gently at about 16 per minute. This was the usual resting condition of heart and respiration.

The head of the beaver was then pressed under water. There was no resistance, and as soon as the head was immersed the animal relaxed and lay with its head resting on the bottom. It made no effort to raise its head until about five minutes had passed, when, after some brief struggling, it was impossible to hold it down longer. Upon emerging, the breathing movements were only slightly increased in amplitude and frequency. The observation was repeated four more times at intervals.

While the beaver was submerged the heart-beat could not be detected, although the position of the animal's thorax was not altered. It is unlikely that the heart entirely stopped, but it certainly diminished greatly in vigor. It is known that in the duck, seal and muskrat the heart is slowed during apnoea.

The docility of our beaver also allowed us to observe the animal's heart while one of us compressed the animal's trachea with his hands. After respiratory movements had completely ceased, from 6 to 10 normal heart-beats were distinctly felt, and then no further movement within the thorax. This observation, which was repeated three times, showed that there was no change in the thorax during apnoea, which made it impossible to detect the normal heart-beat, and that the inhibition of cardiac activity was a regular accompaniment of apnoea.

When it is considered how violent the struggles of an asphyxiated land animal are and how savagely even man combats interference with his process of respiration, it is remarkable that the wild beaver should have submitted so readily to forced submergence and violent closure of its trachea. The observed muscular relaxation and the inhibition of the action of the heart are probably part of the physiological adjustment of the beaver to submergence, as Paul Bert and Richet demonstrated them to be in the duck.

Apparently metabolism is by no means suspended during diving, for after the five-minutes apnoea the beaver's heart beat more strongly at from 75 to 90 per minute during several minutes. It was evidently repaying the oxygen debt which was incurred during the period of apnoea. That the heart showed such a slight acceleration after 5 minutes of asphyxia suggests that the limit of its endurance had by no means been reached. We received reports from three experienced rangers who had observed beavers resting on the bottom while submerged for 15 minutes, and we feel convinced that the capacity of the beaver for resisting asphyxia is exceptional when contrasted with the ability of a land mammal.

LAURENCE IRVING
M. D. ORR

UNIVERSITY OF TORONTO

LATEX TEST FOR MATURITY OF PAPAYA FRUITS

THE immature fruit of the papaya (*Carica papaya*) contains the enzyme papain.[1] The concentration of this enzyme in the juice reaches its maximum when the green fruit is fully grown in size, and then decreases as the fruit matures, apparently disappearing when full maturity is reached.[2] As the papaya fruit matures the following changes are readily apparent—the color of the flesh and placentae changes to orange or peach pink, depending on variety character, the seeds turn black, the flesh softens and its sweet taste increases with a decrease in effective acidity (increase in pH). The color of the juice also changes with maturity. When the immature green fruit is punctured a milky juice is exuded. The milkiness of the juice becomes less and less as maturity proceeds until the stage is reached when the fruit matures on the tree and the juice exuded is colorless and finally ceases to exude at all. When fruits capable of exuding juice are cut in half, the exudation following pune-

[1] A. Wurtz and E. Bouchut, *Compt. Rend. Akad. Sci. Paris*, 89: 425–429, 1879.

[2] Ellis Thomas and V. A. Beckly, *Jour. Dept. Agric. So. Africa*, 6: 357–360, 1923. F. A. Stockdale, *Dept. Agric. Ceylon. Leaflet*, 44, 1926. V. A. Pease, "Papaya and Papain." (A mimeographed publication of the Bur. Chem. and Soils, U. S. Dept. of Agric.) 1933.

turing rapidly declines, beginning near the cut end and ending finally on the ridge farthest from the cut surfaces.

Preliminary observations indicate that the change in color of the exuded juice may be used as a maturity test and that the best time to harvest the fruit is when the exuded juice has become almost or wholly colorless. Earlier picking results in an inferior product and later picking reduces the keeping quality. The complete results will be published later when the experiments now in progress are concluded.

HAMILTON P. TRAUB
T. RALPH ROBINSON
H. E. STEVENS

BUREAU OF PLANT INDUSTRY
U. S. DEPARTMENT OF AGRICULTURE

BALLOONING OF AN ADULT BLACK WIDOW SPIDER

IT is generally known among workers that the young of the black widow spider (*Latrodectus mactans* Fabricius) are dispersed by means of ballooning. Illingworth (1931)[1] states that in Hawaii black widow spiderlings are dispersed by the wind blowing them along with their thin, light ballooning threads; even going out to sea.

However, on September 16, 1935, at about 11 A.M. I was walking across a vacant lot in East Denver. The day was fair and slightly breezy. When I was about half-way across the lot, I happened to look up and see a mature black widow spider ballooning. The spider had its appendages contracted, and it was about eight feet above the ground; as I watched, it continued to rise higher and finally disappear. The several threads of silk supporting the spider in mid-air were about seven to eight feet long. Further observations of like occurrences may possibly bring out the significance of this phenomenon.

ALBERT MILZER

UNIVERSITY OF COLORADO

AIR-MASS AND FRONTAL ANALYSIS BY TELETYPE AND RADIO

TRANSMISSION by teletype and radio of the analysis of the morning weather map, in accordance with the air-mass system employed in the Division of Meteorological Physics of the Central Office of the Weather Bureau, Washington, D. C., was begun last October 15. The data, in code form, are placed on the teletype circuit daily at Washington, except Sundays and holidays, at 11:36 A. M. (E. S. T.) and are relayed to all airway communication circuits for entry on the manuscript maps at the various airports and for subsequent study and use of persons consulting them. City offices of the Weather Bureau receive the information by teletype, telephone or mail from nearby airports. Data for Sundays and holidays are transmitted the next working day immediately following the current day's analysis.

SNOWDEN D. FLORA

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

LOCAL BRANCHES

IT is almost a year since the first Local Branch of the American Association for the Advancement of Science was organized. Six such branches are now operating, and several added groups have held preliminary meetings, looking toward organization. It is too early to discuss the success of these branches, but a descriptive statement about their operation and suggestions may be given that will be useful to those who plan other branches. The idea of local branches was discussed at length by Dr. J. McKeen Cattell in SCIENCE for December 21, 1934.[1] Reprints of that discussion may be had by application to the general secretary of the American Association for the Advancement of Science.

The six branches already approved by the Council of the American Association for the Advancement of Science, in the order of their organization, are: The Lancaster (Pa.) Branch of the A. A. A. S., the Kingston (R. I.) Branch of the A. A. A. S., the South Florida (Miami) Science Association, the Phoenix (Ariz.) Branch of the A. A. A. S., the Westchester (Yonkers) Institute of Sciences, and the Mobile Academy of Science. Each of these branches is autonomous in its procedures. Each elects a president or chairman, a secretary and a treasurer. Some also have one or more vice-presidents, an executive committee, a program committee and other committees on special needs relating to place of meeting, research, publicity, membership and luncheons or dinners. In most cases the organization is simple, the officers serving as the executive committee, with authority to appoint temporary special committees, as occasion may make desirable. In some branches there is an honorary president or chairman. This plan permits the branch to recognize and gain help from an outstanding citizen who can hardly be expected to attend committee meetings regularly.

Membership in the branches includes persons with

[1] J. F. Illingworth, *Proc. Hawaiian Ent. Soc.*, 7: 410–414, 1 pl., 1931 (cited by Charles E. Burt).

[1] J. McKeen Cattell, SCIENCE, Vol. 80, 1934.

all sorts of interest in science. Naturally, members of the A. A. A. S. are interested in local branches, even though they can not participate. In most cases, however, it has been members of the A. A. A. S. who have been the leaders in assembling the initial local groups. The entire membership of each branch is much larger than the total number of local members of the A. A. A. S. Those not members of the A. A. A. S. do not need to join the national organization in order to join the local branch. Undoubtedly, many will sometime join the national organization, but if so, they will join individually, as in the past. That is, membership in a local branch does not carry with it membership in the national organization. None of the magazines of the national organization are sent to branch members unless they have individually arranged for that. But branch membership does increase the availability of scientific books and magazines in libraries and from association members, who can lend their own copies for use by branch members. It must be made clear, however, that members of a local branch are not unduly urged to join the national organization, though they will be welcomed if individually they want to apply for such membership.

The types of persons who compose a local branch vary greatly. In some smaller branches those interested and engaged in research make up the membership. In others, educated people of a wide range of interests make up the membership—not only scientists, but business and professional people, lawyers, doctors, ministers, women from homes and from business, students and teachers. This second kind of branch brings science in its widest sense to all sorts of educated people. In a very real sense, this type of branch best serves the purposes in mind when the executive committee first proposed the organization of branches. It represents a good combination of research science with the most intelligent aspect of consumer sciences. It enables many people to have a good time together in their common commitment toward enlightened pleasure.

Some of the branches have adopted a constitution. I quote from the proposed constitution of the Phoenix Branch:

> A constitution has been drawn up providing for four classes of membership:
>
> (1) Active members, who must be members of the A. A. A. S. or an affiliated society.
>
> (2) Affiliate members, who may be any person over 21 years of age.
>
> (3) Student members, who may be persons regularly enrolled in college.
>
> (4) Honorary members. The number of honorary members may not exceed 10 at any time.
>
> Dues for active and affiliated members are $2.00 per year, for student members, 50¢ per year.
>
> A Board of Counselors, consisting of 15 active members, will control the affairs of the organization. The counselors are elected, 5 each year, for a term of 3 years. From the Board of Counselors an Executive Committee consisting of the President, Vice President, and Secretary and the Chairman of four standing committees is chosen.

In the Phoenix Branch only active members may vote or hold office. I am of the opinion that in all the other branches the active and affiliated or associated members are equal in all responsibilities and privileges of the branch. Also, most of the branches do not restrict membership by younger people. The annual dues range from one to two dollars. These funds, supplemented in some cases by individual contributions, have provided for the expenses.

There seems to be no need of making a lower limit of the number of members that may compose a branch. One branch began with a score of members, has now grown to fifty and is prospering and enthusiastic. The Lancaster branch has made the astonishing limit of one thousand members, and is within less than fifty of reaching its limit. It is too early to judge the success of so large a branch, but it is pleasing to know that science is the subject of an organization which, for the present at least, is "the thing" in a community which has been accustomed to the good features of a highly enlightened environment.

Programs for meetings have ranged from open discussions, participated in by many members, to formal lectures by speakers of national repute. Each branch has in its membership persons who are quite competent to give valuable lectures in fields of their own special concern. Local areas are thus discovering a wealth of local science sometimes not previously understood or recognized. With a broad interpretation of science each community can build an important part of its year's programs by use of its own members. Then, addresses and demonstrations by those from neighboring educational and research institutions, as well as less frequent addresses by persons from greater distances, have been used with great success. Admission to these programs is free to all branch members. Nonmembers are usually admitted upon payment of a small fee for each program attended. Radio programs for the branches seem to offer peculiar opportunities. If an important radio address has been announced, the secretary may send announcements to the members who may hear the address at home, or in small discussion groups, or in a larger meeting of the entire branch. This feature offers opportunities not yet well developed.

Topics of addresses given before some of the branches are suggestive. Such are: "Pre-Roman Archeology of the British Isles"; "Are Our Beliefs Scientific?"; "Some Needed Scientific Studies in This

Community"; "Science and Music"; "Some Unpublished Psychology"; "How Can Deaf Children Best Be Taught?"; "What About Cosmic Rays?"; "Newer Knowledge of Learning Processes"; "Science as a Career"; "Radio Engineering"; "Greenhouses and Illuminating Gas"; "The Science of Potato Growth"; "Our Community's Health"; "Why Not Live Longer?"; and many others. Science has now accumulated so much knowledge that a year's program may consist of almost anything which interests the members.

The success and usefulness of a local branch depends upon the quality of the local leadership. The inherent need and opportunity for the work of a branch seems to exist in almost any community. Possibly a few regions are already so well organized that no field of service remains for such an organization. Certainly most science men hardly need to join anything more in order to keep their time well filled. It is peculiarly true, however, that busy people are the ones most likely to find the time and inclination and to have acquired habits of organizing themselves and other people for new productive efforts.

OTIS W. CALDWELL,
General Secretary, American Association for the Advancement of Science

THE NATIONAL ACADEMY OF SCIENCES. II.

ABSTRACTS OF PAPERS PRESENTED AT THE AUTUMN MEETING[1]

(*Continued from page 541*)

Calcium as a factor in the nutritional improvement of health: H. C. SHERMAN. Starting with a food supply already adequate to the support of normal health, generation after generation, it was found possible to induce a higher degree of nutritional well-being (a superior internal environment for the life process) with resultant improvement of "positive" or "buoyant" health throughout the life cycle, by enrichment of the dietary in certain of its chemical factors. In the original experiments the improvement was brought about by adjustment of the quantitative proportions of the natural articles of food which composed the dietary. In terms of the actual foods there was only one experimental variable; but in terms of the chemical interpretation, four factors may have been involved, namely, calcium, protein and vitamins A and G (B_2). New experiments dealing separately with calcium are here reported. These show that the improvement of nutritional well-being and health previously noted was largely but not wholly due to the more liberal intake of calcium. When the original food supply (Diet A) was enriched in calcium only, and only to the same extent as in the previous experiments, there resulted improvement in the rate, efficiency and uniformity of growth, a decrease of death rates at all ages, a higher level of adult vitality with longer period between the attainment of maturity and the onset of senility and an increase in the average length of life. Experiments with diets of still more liberal calcium content are now in progress, and the effects of enrichment of intake of protein, of vitamin A and of vitamin G are also being studied.

An analysis of color-blindness in eleven thousand museum visitors: W. R. MILES.

Action potentials of various layers of the cerebral cortex of the monkey: J. G. DUSSER DE BARENNE and WARREN S. MCCULLOCH. It is well known that "spontaneous" action potentials are obtainable from the cerebral cortex of animals and man, even when deeply anesthetized. These action potentials, amplified with a 2-stage d.c. amplifier and recorded with a cathode ray oscillograph, were investigated in the cortex of monkeys under Dial anesthesia. Small silver—silver chloride electrodes, 2 to 3 mm apart, were used throughout. In combination with the method of laminar thermocoagulation, which permits one to destroy, at will, any number of consecutive layers of the cortex, it is possible to approach the problem of the action potentials originating in various layers of the cortex. After thermocoagulation, involving in each instance an area of 5×7 millimeters, the electrodes were replaced exactly in their original positions, well within the area coagulated. The results to be reported here are the following: (1) Thermocoagulation of the entire thickness of the cortex (80° C. for 5 seconds) immediately and permanently abolishes the action potentials normally found in the particular cortical area. (2) Laminar thermocoagulation of the outer four layers (70° C. for from 4 to 4½ seconds) reduces the local action potentials almost completely and permanently. (3) Destruction of the outer three layers (70° C. for 3 seconds) reduces the local action potentials markedly with little or no evidence of any return to their original size and form. This reduction is much less than that noted sub 2. (4) Laminar thermocoagulation of the outer two layers (65° C. for 3 seconds) results in a definite reduction in the action potentials from which there is some recovery, though they do not regain their initial size and shape at the end of one hour. The finding sub 1 shows that the electrical phenomena recorded under the conditions of these experiments arise in the cortical area under investigation. The findings sub 2, 3 and 4 show that the action potentials remaining after any thermocoagulation originate in the remaining layers of the cortex. (5) Laminar thermocoagulation of the outer three layers (70° C. for 3 seconds) of one area (5×7 mm) in the precentral, postcentral or frontal region produces changes in the local action potentials

[1] Charlottesville, Va., November 18, 19 and 20, 1935.

within each of the other two regions. Without thermocoagulation, even in the course of several hours, no such reduction occurs. These findings demonstrate the existence of a functional interrelation among these three regions.

Biographical memoir of Edgar Fahs Smith: GEORGE H. MEEKER.

The extinct giant ground-sloths of North and South America: W. B. SCOTT.

The great tree of proboscidean descent: summary of our knowledge of the origin, adaptive radiation and geographic distribution of the proboscidea of the world: THE LATE HENRY FAIRFIELD OSBORN.

The mechanism of geysers: ARTHUR L. DAY. Bunsen's theory of geysers was published in 1847 in explanation of the behavior of the Great Geyser of Iceland. Although Bunsen himself did not extend his explanation to cover other geysers which he had not seen, nevertheless his theory has found general acceptance among geologists as a satisfactory explanation of all geyser action, apparently without question of the appropriateness of the generalization. One of the reasons for this is perhaps found in the fact that the literature records more studies of laboratory models of geyser action than of field studies of the geysers themselves and that these models are uniformly designed in accord with the conditions assumed in Bunsen's theory, namely, a constant heat supply and a limited (constant) water supply. In an investigation of the hot springs of Yellowstone Park covering a number of years, some study has been given to the behavior of well-known geysers in that region and to the behavior of models based on Bunsen's theory. There is wide divergence of behavior between the actual geysers and the conventional models which extends to many important details and brings out a number of facts not hitherto noticed, which are of considerable interest to students of geyser action, whether they be physicists or geologists. Conspicuous among these differences is the fact that the Great Geyser of Iceland and all the models since made for laboratory study erupt for periods more or less uniform in length and the time intervals between eruptions also are more or less constant. Except for Old Faithful, few of the 200 geysers in Yellowstone Park which are known to us present this constancy of behavior. Neither do they conserve or return to its source any considerable proportion of the water erupted, as the Great Geyser does. The problem is therefore considerably more complicated and perhaps more interesting than Bunsen found it to be. This paper will therefore endeavor to present the results of a considerable number of field and laboratory observations and some conclusions and generalizations which may be drawn from them.

The frequency distribution of lunar craters with reference to size: F. E. WRIGHT. In a recent publication by M. A. Blagg and K. Mueller, entitled "Named Lunar Formations" (Vol. I, Catalogue; Vol. II, Maps) and issued by the International Astronomical Union, the designations and coordinate locations of 6,019 lunar surface features are listed. In this number there are included 3,119 craters (walled craters, holes, ring plains); 485 crater formations not fully enclosed; and 235 irregular and indistinctly walled plains. The diameter of each crater is given; all craters in the list have a diameter of at least two miles. With these data as basis, plots have been prepared which show the frequency distribution of lunar craters with reference to size. The distribution curves are remarkably smooth and approximately exponential in character. It is known that the different types of lunar craters pass in all gradations from one to the other. However, a satisfactory explanation of the character of the frequency distribution curves has not yet been found. A comparison of the frequency distribution of terrestrial craters of different sizes with that of lunar craters has not been possible because of the paucity of available data on terrestrial craters.

Geological setting of the archeology of Lake Tacarigua, Venezuela: EDWARD W. BERRY. An attempt will be made to set forth what is known of the geology of Lake Tacarigua, a region in northern Venezuela, which was thickly settled in pre-Columbian times, and one which has yielded extensive archeological and anthropological materials. The conclusion is reached that the cultural horizons extend back to ancient historic times but are much younger geologically than has been supposed.

Ferrous metasilicate in nature: NORMAN L. BOWEN. In the laboratory synthesis of minerals, with the purpose of throwing light upon the conditions of their formation in nature, it is found that metasilicates of most of the common oxides can be prepared without difficulty and their thermodynamic relations can be fully established. Attempts to prepare ferrous metasilicate ($FeSiO_3$) have, however, failed and the conclusion has been reached that ferrous oxide does not combine with silica in the metasilicate ratio, a conclusion that seemed justified because a natural mineral of that composition has not been found hitherto. Compounds related to $FeSiO_3$ and solid solutions approaching the composition $FeSiO_3$ rather closely are well known among natural and synthetic minerals and the variation of their properties with change of composition has been carefully determined. The properties of $FeSiO_3$ may therefore be said to be rather accurately known, in spite of the fact that no one has ever had any crystals of that composition for purposes of measurement. In the lithophysae of an obsidian from Lake Naivasha, Kenya, minute crystals have now been found whose properties agree entirely with the deduced properties of $FeSiO_3$, and there seems no escape from the conclusion that they have substantially that composition. Efforts to determine by laboratory methods the conditions under which $FeSiO_3$ may be formed must therefore be renewed. The indications from the natural occurrence are that the crystals were formed at low temperatures, a relation that may account for failure to prepare them synthetically. Silicate reactions proceed so slowly at low temperatures

that it may be necessary to have recourse to some stimulus such as a "catalyst" to ensure equilibrium in reasonable time. Nature has at her disposal an abundance of "catalysts" and limitless time.

William Barton Rogers and his contribution to the geology of Virginia: JOSEPH K. ROBERTS.

Geographic distribution of sea-level cosmic-ray intensities: R. A. MILLIKAN and H. VICTOR NEHER. With Neher self-recording electroscopes sent to many parts of the globe on ten different ships a precision survey has now been completed of the variation of cosmic-ray intensities with both latitude and longitude, so that the earth as a whole can now be covered with sea-level equal intensity cosmic-ray lines. The electroscopes run automatically for three months without attention, save for the occasional winding of a clock. The films are developed after return to the laboratory at Pasadena, and are measured by different observers so that the personal equation is largely eliminated. The major changes in sea-level cosmic-ray intensities can be described as follows: In going along the longitude line 75° W., which runs from the far north through Washington and along the west coast of South America, there is no appreciable change until the magnetic latitude of about 42° is reached. The equatorial dip then begins to set in and shows a maximum decline of 8 per cent. off Peru and returns again to its normal value off Cape Horn. In going south from Liverpool through the Atlantic Ocean—Longitude 30° W.—and around Cape Horn the maximum dip is 8.5 per cent. In going south from Alaska in Latitude 165 W. to New Zealand the maximum dip is 10 per cent. In going along Longitude line 80° E. through southern India the maximum dip is 12 per cent. In the region most accurately studied—the west coast of the United States—the intensity remains remarkably constant until the latitude of Pasadena—about 42° magnetic—is reached, and then drops remarkably suddenly. In the Atlantic Ocean the drop sets in at about the same magnetic latitude with equal suddenness. It appears also to take place quite suddenly at about magnetic latitude 42° in the southern hemisphere. Nevertheless, the existence of a longitude effect shows that in strictness there is no such thing as magnetic latitude. In other words, the earth's magnetic field, even at the remote distances of thousands of miles at which these deflections occur, is strikingly dissymmetrical with respect to any line passing through the earth's center. This method of study opens up the possibility of determining these dissymmetries at large distances from the earth. The observed magnetic effects are to be expected quite independently of whether cosmic rays are in their origin photonic or corpuscular. This survey has been carried on with the aid of a grant made by the Carnegie Corporation of New York, administered under the Carnegie Institution of Washington. The authors wish to express appreciation for this assistance.

Anthropological excavations on Kodiak Island: A. HRDLIČKA.

Exploration of a mound at Belle Glade, Florida: M. W. STIRLING. The site consists of a habitation mound rich in artifacts of bone, shell, stone, wood and pottery, and a burial mound which revealed three periods of construction. It was composed of a primary mound of muck with two later additions built of sand, the latter containing objects of sixteenth century Spanish origin. Unique architectural features were a limestone pavement in front of the mound and a log stairway leading up the face. More than 1,000 burials were encountered. Here for the first time in Florida was recovered a representative collection of kitchen midden artifacts, burial furniture and skeletal material all from one site. Historical information links the site with the now extinct Calusa Indians, enabling the identification of other sites exhibiting the same culture.

Relations of symmetry in the developing ear of amblystoma: ROSS G. HARRISON.

The copper beech and the sugar maple: WILDER D. BANCROFT and JOHN E. RUTZLER, JR. The leaves of the copper beech may vary in color in different parts of the tree at the same time, and the same leaves may vary in color from week to week. Some years, the sugar maples in Ithaca turn a wonderful red and other years they will be yellow with only spots of red. The ultra-violet light which passes through glass develops the red in the copper beech; but it acts by stimulating enzymes and not directly. Sunshine and cool nights are factors in turning maple leaves red; but no direct correlation between weather conditions and red maple leaves is possible at present. What Willstätter calls internal factors are of tremendous importance, because the leaves of the copper beech turn yellow in the fall under weather and soil conditions which produce red in a sugar maple alongside. The problem of autumn coloring is primarily an enzyme problem and must be studied as such.

(To be continued)

BOOKS RECEIVED

Annals of the Dearborn Observatory of Northwestern University. Vol. III: *Stellar Parallaxes* by PHILIP FOX. Pp. 194. 18 figures, 3 plates. The University.

HARDING, ARTHUR M. *Astronomy.* Pp. x + 418. Illustrated. Garden City Publishing Co., Garden City, N. Y. $1.98.

JENNINGS, H. S. *Genetic Variations in Relation to Evolution.* Pp. 139. 21 figures. Princeton University Press. $2.00.

MOORE, ELIAKIM H. *General Analysis. Part I.* Vol. I, 1935 of the *Memoirs of the American Philosophical Society.* Pp. 231. The Society, Philadelphia.

Second Report of the Science Advisory Board, September 1, 1934 to August 1, 1935. Pp. 494. 6 figures. National Research Council, Washington, D. C.

Erratum: In the Scientific Event entitled "The Simplification of International Weather Reports" in the issue of SCIENCE for November 29, in the fifth line from the bottom of the first column "now" should be substituted for "not."